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(54) **Surfactant composition.**

(57) A surfactant composition containing a fatty acid polyoxyalkylene lower alkyl ether represented by formula (1):



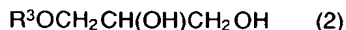
wherein R represents an alkanoyl or alkenoyl group having from 10 to 18 carbon atoms;

R¹ represents an alkylene having from 2 to 4 carbon atoms;

R² represents a lower alkyl group; and

n is from 5 to 100 on the average;

and a fatty acid monoglyceride represented by formula (2):



wherein R³ represents an alkanoyl group having from 8 to 16 carbon atoms or an alkenoyl group having from 12 to 22 carbon atoms;
are disclosed.

The foaming properties of a fatty acid polyoxyalkylene lower alkyl ether of formula (1) are improved by adding a fatty acid monoglyceride represented by formula (2) to the fatty acid polyoxyalkylene lower alkyl ether of formula (1).

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BACKGROUND OF THE INVENTIONField Of The Invention

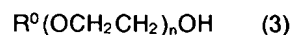
- 5 This invention relates to a surfactant composition having satisfactory foaming properties, though it comprises a specific nonionic surfactant which has poor foaming properties.

Description Of The Background

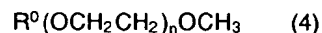
- 10 Nonionic surfactants such as polyoxyethylene surfactants, polyhydric alcohol ester surfactants and ethylene oxide/propylene oxide block copolymer surfactants are generally less irritative to the skin including mucosae. Further, the nonionic surfactants do not ionize over a wide range of pH values ranging from weakly acidic to weakly alkaline, which makes it easy to control the pH of a composition containing these nonionic surfactants. Because of these characteristics, the nonionic surfactants have been employed as
 15 emulsifiers or oily stain removers in various products including skin care products, hair care products, kitchen detergents, oral care products, bathing preparations, drugs and cosmetics.

Among the nonionic surfactants, polyoxyethylene nonionic surfactants have been widely employed in particular, since the hydrophilic-hydrophobic balance thereof can be easily controlled by regulating the polyoxyethylene chain length and because they can easily be synthesized.

- 20 In general, ester type nonionic surfactants are superior to the corresponding ether surfactants from the viewpoint of biodegradability. Also, the former is less irritative than the latter. Accordingly, ester type surfactants such as those represented by formula (3):



- 25 which have an alkanoyl group (R^0) derived from a higher fatty acid such as lauric acid, which is a lipophilic group of the polyoxyethylene nonionic surfactant, have been widely employed as emulsifiers. Recently, it has been proposed, for example, in JP-A-4-279552 (the term "JP-A" as used herein means an "unexamined published Japanese patent application") to improve the detergency of a nonionic surfactant
 30 represented by formula (3) by etherifying its terminal OH group with a methyl group as shown in formula (4):



- 35 wherein R^0 represents an alkanoyl group such as lauroyl.

- However a polyoxyethylene nonionic surfactant of the ester type represented by formula (4), the terminal of which has been etherified with a lower alkyl group such as a methyl group, exhibits poor foaming properties similar to other nonionic surfactants. Thus, there arises the problem that a detergent, for example, a hair shampoo or a body shampoo containing such a nonionic surfactant fails to lather well and
 40 thus cannot give a satisfactory feel in use.

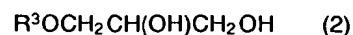
SUMMARY OF THE INVENTION

- Accordingly, one object of the present invention is to provide a surfactant composition having excellent
 45 foaming properties and which is not very irritative to the skin and mucosae, though it contains an ester type polyoxyethylene nonionic surfactant etherified with a lower alkyl group as the main component.

Briefly, this object and other objects of the invention as hereinafter will become more readily apparent can be attained with a surfactant composition containing a fatty acid polyoxyalkylene lower alkyl ether represented by formula (1):

- 50 $R(OR^1)_nOR^2 \quad (1)$

- wherein R represents an alkanoyl or alkenoyl group having from 10 to 18 carbon atoms; R^1 represents alkylene having from 2 to 4 carbon atoms; R^2 represents a lower alkyl group; and n is from 5 to 100 on the
 55 average;
 and a fatty acid monoglyceride represented by formula (2):



wherein R³ represents an alkanoyl group having from 8 to 16 carbon atoms or an alkenoyl group having from 12 to 22 carbon atoms.

Another aspect of the invention is a method for improving the foaming properties of a fatty acid polyoxyalkylene lower alkyl ether by adding a fatty acid monoglyceride represented by formula (2) to a fatty acid polyoxyalkylene lower alkyl ether represented by formula (1).

DETAILED DESCRIPTION OF THE INVENTION

It has now been found that the objective of the invention can be achieved by combining a fatty acid monoglyceride, which is a nonionic surfactant, with an ester type polyoxyethylene nonionic surfactant etherified with a lower alkyl group.

In the surfactant composition according to the present invention, the weight ratio of the fatty acid polyoxyalkylene lower alkyl ether represented by formula (1) to the fatty acid monoglyceride represented by formula (2) preferably ranges from 10:1 to 1:2, more preferably from 5:1 to 1:1, from the viewpoint of foaming properties. The total content of the fatty acid polyoxyalkylene lower alkyl ether of formula (1) with the fatty acid monoglyceride of formula (2) preferably ranges from 0.5 to 20% by weight (in terms of the concentration at use) or from 0.5 to 100% by weight (in terms of the content in the final preparation).

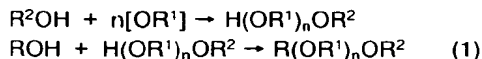
In the fatty acid polyoxyalkylene lower alkyl ether of formula (1) to be used in the present invention, group R is an alkanoyl or alkenoyl group having from 10 to 18, preferably from 10 to 14, carbon atoms such as, for example, decanoyl, lauroyl, myristoyl, palmitoyl or oleoyl. Although both straight-chain and branched chain R groups are usable, straight-chain groups are preferred from the viewpoint of foaming properties. Of all the groups, lauroyl and myristoyl groups are preferred. When the group R has less than 10 carbon atoms, only poor foaming properties and detergency are achieved. When the group R contains more than 18 carbon atoms, on the other hand, the resulting product shows insufficient solubility and reduced foaming properties.

The group R¹ is an alkylene group having 2 to 4 carbon atoms such as ethylene, propylene, isopropylene, butylene or isobutylene. Of all the groups, the ethylene group is preferred. Alternatively, two or more groups selected from among the above-mentioned groups may be present in a surfactant molecule. For example, a polyoxyalkylene block copolymer obtained by block copolymerization of ethylene oxide with propylene oxide is usable. In formula (1), n, which is the degree of polymerization of the polyoxyalkylene, ranges from 5 to 100, preferably from 10 to 50, on the average. If n is less than 5 on the average, the resulting product has insufficient solubility in water. If n exceeds 100, on the other hand, the resulting product has poor foaming properties and detergency.

Group R² is a lower alkyl group such as, for example, methyl, ethyl, or isopropyl. From the viewpoint of synthesis procedures and cost, a methyl group is particularly preferred.

As the fatty acid polyoxyalkylene lower alkyl ether represented by formula (1), those produced by known methods as disclosed, for example, in JP-A-53-24930, JP-A-54-1038125, JP-A-56-36431 and JP-A-4-279552, may be employed. However, preferred for use is a fatty acid polyoxyalkylene lower alkyl ether of formula (1) which is obtained by reacting a lower alcohol such as methanol with an alkylene oxide such as ethylene oxide to give a polyoxyalkylene lower alkyl ether, and then reacting this product with a fatty acid, as shown in the following reaction scheme. This method causes little contamination of the product with impurities or by-products.

Reaction scheme



wherein R, R¹ and R² have each the same meaning as defined above for formula (1); and [OR¹] represents an alkylene oxide having from 2 to 4 carbon atoms.

In the fatty acid monoglyceride of formula (2), group R³ is an alkanoyl group having from 8 to 16, preferably from 10 to 12, carbon atoms such as octanoyl, decanoyl, lauroyl, or palmitoyl or an alkenoyl group having from 12 to 22, preferably from 16 to 20, carbon atoms such as palmitoleyl or oleoyl. When group R³ has carbon atoms in a number outside the range specified above, the fatty acid polyoxyalkylene lower alkyl ether exhibits no improvement in foaming properties.

From the viewpoint of foaming, it is more desirable that the fatty acid monoglyceride of formula (2) contains a lower content of contaminating fatty acid diglycerides and triglycerides. Therefore, it is preferred

to refine a marketed product before use by distillation, for example, in order to give a monoglyceride concentration of 80% by weight or above, preferably 90% by weight or above.

In addition to the fatty acid polyoxyalkylene lower alkyl ether of formula (1) and the fatty acid monoglyceride of formula (2), the surfactant composition of the present invention may contain various additives if needed, so long as the low irritativeness quality of the product is not impaired. Examples of such additives include other surfactants such as anionic surfactants, cationic surfactants, other nonionic surfactants and ampholytic surfactants; inorganic salts such as sodium chloride; amino acid salts such as lysine and arginine salts; pH regulators such as citrates; alcohols such as ethanol; propylene glycol, glycerol, sorbitol, polyethylene glycol and alkyl ethers thereof; and water soluble polymers such as xanthan gum, acrylic acid polymers, cationized cellulose, methacrylic acid ampholytic polymers and carboxymethyl cellulose.

Because it is less irritative, the surfactant composition of the present invention is highly applicable to the human body including the face, hands and hair. It can be applied in the form of liquid, cream, gel, mousse, powder or solid. The surfactant composition of the present invention can be packed in containers, for example, bottles, tubes and foamers such as pump foamers and squeeze foamers depending on its form of use.

When the surfactant composition of the present invention is formulated into a liquid preparation, it is usually desirable to use water as the solvent.

The surfactant composition of the present invention can be produced by conventional methods. For example, it can easily be produced by homogenizing the fatty acid polyoxyalkylene lower alkyl ether of formula (1) and the fatty acid monoglyceride of formula (2) optionally together with other additives in a mixer under heat or with the application of a mechanical force.

In the production of products containing the surfactant composition of the present invention, it is convenient to prepare a composition of the fatty acid polyoxyalkylene lower alkyl ether of formula (1) and the fatty acid monoglyceride of formula (2) in advance and then the composition is mixed or diluted with other components according to need. In this instance, it is preferred to blend the components (1) and (2) at a weight ratio of from 10:1 to 1:2, more preferably from 5:1 to 1:1, while heating, if necessary, to give a homogeneous mixture.

The surfactant composition according to the present invention contains the fatty acid polyoxyalkylene lower alkyl ether of formula (1), which is only slightly irritative to the skin and mucosae, together with the fatty acid monoglyceride of formula (2), which is also slightly irritative to the skin and mucosae. Thus, the surfactant composition of the present invention shows sufficient foaming properties while being scarcely irritative to the skin and mucosae.

To further illustrate the present invention in greater detail, the following Examples will be given.

EXAMPLES 1 TO 14 AND COMPARATIVE EXAMPLES 1 TO 6

Each of the compounds (fatty acid polyoxyalkylene lower alkyl ethers) of formula (1) and each of the compounds (fatty acid monoglycerides) of formula (2), as shown in Table 1 *infra* were homogeneously mixed in a weight ratio of 2:1 to give surfactant compositions. In the Comparative Examples, no compound of formula (2) was employed.

In Table 1, the expression "lauric acid EO₁₅OMe", for example, means a compound of formula (1), wherein R is C₁₁H₂₃CO, R¹ is C₂H₄, R² is CH₃ and n is 15. The compound is etherified with a methyl group at its terminal. Further, "lauric acid EO₃₀OH", for example, in Comparative Example 7 is a comparison in which the terminal OH group is not etherified.

TABLE 1

	Compound of formula (1)	Compound of formula (2)
Comparative Example 1 Example 1	lauric acid EO ₁₅ OMe ditto	- capric acid monoglyceride
Comparative Example 2 Example 2 Example 3 Example 4	lauric acid EO ₃₀ OMe ditto ditto ditto	- capric acid monoglyceride lauric acid monoglyceride palmitic acid monoglyceride
Comparative Example 3 Example 5 Example 6	myristic acid EO ₃₀ OMe ditto ditto	- capric acid monoglyceride lauric acid monoglyceride
Comparative Example 4 Example 7 Example 8 Example 9	palmitic acid EO ₁₅ OMe ditto ditto ditto	- capric acid monoglyceride lauric acid monoglyceride palmitic acid monoglyceride
Comparative Example 5 Example 10 Example 11 Example 12	palmitic acid EO ₃₀ OMe ditto ditto ditto	- capric acid monoglyceride lauric acid monoglyceride palmitic acid monoglyceride
Comparative Example 6 Example 13 Example 14	stearic acid EO ₄₀ OMe ditto ditto	- capric acid monoglyceride lauric acid monoglyceride
Comparative Example 7 Comparative Example 8	lauric acid EO ₃₀ OH ditto	- palmitic acid monoglyceride

Each of the surfactant compositions of the above Examples and Comparative Examples was subjected to a foaming test as will be described hereinbelow.

Foaming test

100 ml of a homogeneous aqueous solution containing 3 g of the surfactant composition, 1 g of purified lanolin and 1 g of sodium chloride were mixed with care to avoid foaming. The resulting solution was transferred into a 400 ml calibrated cylinder provided with a cap as shown in Fig. 4 and allowed to stand until it was heated to about 35 °C or about 40 °C. Then the cylinder was vigorously shaken 20 times within 10 seconds while holding it vertically to induce foaming. After allowing to stand for 1 minute, the foam volumes X, Y and Z were measured, wherein X means the volume of the foam above the initial liquid face, Y means the volume of the foam from the liquid face after standing to the initial liquid face, and Z means the sum of the foam volumes X and Y. In general, foams become more creamy with an increase in the ratio of the foam volume Y to the foam volume Z. Table 2 shows the results thus obtained.

TABLE 2

	Foam volume (ml) at about 35°C				Foam volume (ml) at about 40°C			
	X	Y	Z	(°C)	X	Y	Z	(°C)
Comparative Example 1	40	20	60	(35.0)	72	9	81	(39.3)
Example 1	230	60	290	(36.1)	220	50	270	(41.0)
Comparative Example 2	20	2	22	(35.4)	100	32	132	(40.9)
Example 2	320	60	380	(35.8)	310	50	360	(40.1)
Example 3	120	40	160	(35.6)	160	50	210	(39.8)
Example 4	36	6	42	(35.7)	78	18	96	(40.3)
Comparative Example 3	36	14	50	(36.2)	75	30	105	(40.4)
Example 5	180	55	235	(35.4)	260	60	320	(41.0)
Example 6	80	20	100	(36.4)	150	35	185	(40.1)
Comparative Example 4	50	8	58	(35.2)	12	4	16	(39.5)
Example 7	95	26	121	(35.4)	150	30	180	(40.2)
Example 8	38	2	40	(36.1)	90	20	110	(40.9)
Example 9	38	8	46	(35.7)	60	20	80	(39.0)
Comparative Example 5	34	7	41	(34.5)	25	10	35	(39.9)
Example 10	125	30	155	(35.5)	250	60	310	(39.1)
Example 11	50	8	58	(35.2)	95	20	115	(40.0)
Example 12	52	6	58	(35.1)	64	10	74	(40.9)
Comparative Example 6	18	5	23	(35.5)	18	4	22	(39.0)
Example 13	140	40	180	(36.0)	135	25	160	(39.0)
Example 14	90	10	100	(35.4)	88	17	105	(40.6)
Comparative Example 7	30	8	38	(35.2)	20	8	28	(39.5)
Comparative Example 8	26	6	32	(35.2)	6	6	12	(39.1)

Note: Each value given in parentheses means the accurate measurement temperature.

As the data presented in Table 2 show, the combined use of lauric acid EO₁₅OMe as the nonionic surfactant of formula (1) with a fatty acid monoglyceride of formula (2) generally cause an increase in the foam volume compared to the case where EO₁₅OMe was used alone (measured at about 35°C). When the temperature was elevated from about 35°C to about 40°C, a large change in the foam volume was observed in the instance where EO₁₅OMe was used alone, while the combined use caused little change in

the foam volume. These facts indicate that the latter surfactant composition showed a higher foam stability against temperature change.

Regarding the fatty acid monoglycerides of formula (2), the combined use of the nonionic surfactant of formula (1) with capric monoglyceride (Example 1 and Comparative Example 1) resulted in excellent foam properties. When the EO addition mole number was increased from 15 to 30 (Examples 2 to 4 and Comparative Example 2), the combined use with capric acid monoglyceride resulted in the most excellent foaming properties, compared to the cases where lauric acid monoglyceride or palmitic acid monoglyceride was used.

When myristic acid EO₃₀OMe (Examples 5 and 6 and Comparative Example 3), palmitic acid EO₁₅OMe (Examples 7 to 9 and Comparative Example 4), palmitic acid EO₃₀OMe (Examples 10 to 12 and Comparative Example 5) and stearic acid EO₄₀OMe (Examples 13 and 14 and Comparative Example 6) were used as the nonionic surfactant of formula (1), a tendency similar to the one observed using lauric acid EO₃₀OMe was observed in each case. Namely, the most excellent foaming properties were achieved using capric acid monoglyceride together with the nonionic surfactant and the combined use with lauric acid monoglyceride was preferred from the viewpoint of creamy foaming.

Further, when lauric acid EO₃₀OH, the terminal OH group of which is not etherified, was used as the nonionic surfactant of formula (1) (Comparative Examples 7 and 8), the foaming properties of the resulting composition were poor.

EXAMPLE 15

The components (1) to (9) listed in the following Table 3 were homogeneously mixed to provide a facial cleanser.

TABLE 3

	Component	Content (% by weight)
(1)	Lauric acid polyoxyethylene methyl ether (EO addition mole number: 20, total molecular weight: 1100)	20.0
(2)	Lauric acid monoglyceride (Sunsoft 750H, a product of Taiyo Kagaku K.K.)	8.0
(3)	Monosodium citrate	0.1
(4)	Propylene glycol	4.0
(5)	Magnesium stearate	0.1
(6)	Alkox E-100 (Alkox E-100, a product of Meisei Kagaku Kogyo K.K.)	0.1
(7)	Preservative (methyl parabenzoate)	appropriate amount
(8)	Perfume	appropriate amount
(9)	Purified water	balance
	Total	100.0

The facial cleanser thus obtained showed sufficient foaming and very little irritation to the skin and eyes.

EXAMPLE 16

The components (1) to (9) listed in the following Table 4 were homogeneously kneaded and molded to give a soap-like solid detergent.

TABLE 4

	Component	Content (% by weight)
5	(1) Coconut fatty acid polyoxyethylene methyl ether (EO addition mole number: 25, total molecular weight: 1350)	55.0
	(2) Lauric acid monoglyceride (Sunsoft 750H, a product of Taiyo Kagaku K.K.)	25.0
10	(3) Capric acid monoglyceride (Sunsoft 760, a product of Taiyo Kagaku K.K.)	4.0
	(4) Sorbitol powder	1.2
	(5) Dipotassium glycyrrhetinate	0.02
	(6) Solid paraffin	0.05
	(7) Soluble starch	15.0
15	(8) Perfume	appropriate amount
	(9) Purified water	balance
	Total	100.0

The soap-like solid detergent thus obtained showed sufficient foaming and very little irritation to the skin and eyes.

The surfactant composition of the present invention shows sufficient foaming properties and scarcely irritates the skin or mucosae. Accordingly, the use of the surfactant composition of the present invention, as the main component of a soap or a shampoo, results in little irritation to the skin and mucosae, excellent foaming and a satisfactory feel to the skin.

While the invention has been described in detail and with reference to specific examples thereof, it will be apparent to one skilled in the art that various changes and modifications can be made therein without departing from the spirit and scope thereof.

Claims

1. A surfactant composition comprising a fatty acid polyoxyalkylene lower alkyl ether represented by formula (1):



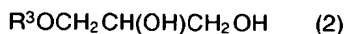
wherein R represents an alkanoyl or alkenoyl group having from 10 to 18 carbon atoms;

R¹ represents an alkylene having from 2 to 4 carbon atoms;

R² represents a lower alkyl group; and

n is from 5 to 100 on the weight-average;

and a fatty acid monoglyceride represented by formula (2):



wherein R³ represents an alkanoyl group having from 8 to 16 carbon atoms or an alkenoyl group having from 12 to 22 carbon atoms.

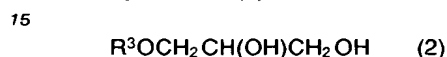
2. The surfactant composition of claim 1, wherein the weight ratio of the fatty acid polyoxyalkylene lower alkyl ether of formula (1) to the fatty acid monoglyceride of formula (2) ranges from 10:1 to 1:2.
3. The surfactant composition of claims 1 or 2, wherein the group R¹ in formula (1) is ethylene and the group R² in formula (1) is methyl.
4. The surfactant composition of any one of claims 1 to 3, wherein the group R in formula (1) is lauroyl or myristoyl.
5. The surfactant composition of any one of claims 1 to 4, wherein group R³ in formula (2) is decanoyl or lauroyl.

6. The surfactant composition of any one of claims 1 to 5, wherein said fatty acid polyoxyalkylene lower alkyl ether of formula (1) and said fatty acid monoglyceride of formula (2) are present in a total content of from 0.5 to 20% by weight.

- 5 7. A method for improving the foaming properties of a fatty acid polyoxyalkylene lower alkyl ether represented by formula (1):



- 10 wherein R represents an alkanoyl or alkenoyl group having from 10 to 18 carbon atoms;
 R¹ represents an alkylene having from 2 to 4 carbon atoms;
 R² represents a lower alkyl group; and
 n is from 5 to 100 on the average, which comprises adding a fatty acid monoglyceride represented by formula (2):



- wherein R³ represents an alkanoyl group having from 8 to 16 carbon atoms or an alkenoyl group having from 12 to 22 carbon atoms;
 20 to the fatty acid polyoxyalkylene lower alkyl ether.

8. The method of claim 7, wherein the fatty acid monoglyceride is added in such a manner as to give a ratio of the fatty acid polyoxyalkylene lower alkyl ether of formula (1) to the fatty acid monoglyceride of formula (2) of from 10:1 to 1:2.

- 25 9. The method of claims 7 or 8, wherein the group R¹ in formula (1) is ethylene and the group R² therein is methyl.

10. The method of any one of claims 7 to 9, wherein the group R in formula (1) is lauroyl or myristoyl.

- 30 11. The method of any one of claims 7 to 10, wherein the group R³ in formula (2) is decanoyl or lauroyl.

12. The use of compounds of formula (1) and (2), as defined in claim 1, together in a surfactant composition to give a composition having satisfactory foaming properties which is not very irritative to the skin and mucosae.

- 35 13. A cosmetic composition comprising the surfactant composition as defined in any one of claims 1 to 6.

- 40 14. The cosmetic composition according to claim 13 which is a soap-like solid detergent or a facial cleanser.

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European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 94 12 0398

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X,P	EP-A-0 617 955 (KAO CORPORATION) * page 4, line 2-47; example 6 * -----	1-14	A61K7/50 A61K7/48 C11D1/825 C11D1/94
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			A61K C11D
The present search report has been drawn up for all claims			
Place of search BERLIN		Date of completion of the search 19 April 1995	Examiner Cordero Alvarez, M
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